REMOTE SENSING UTILITY IN A DISASTER STRUCK URBAN ENVIRONMENT

Annual Progress Report

October 1, 1973-December 1, 1974

by

Principal Investigator

Marjorie Rush, Ph.D.

Co-Principal Investigator

Alfonso Holguin, M.D., M.P.H.

Research Associate

Sally Vernon, M.A.

University of Texas Health Science Center

School of Public Health

Houston, Texas 77025

NASA Grant # NGL 44-084-003

A. STATEMENT OF GOALS AND OBJECTIVES

1. Remote Sensing and Public Health. The general purpose of this research is to explore and present ways that a new technology--remote sensing--can contribute to solutions of urban public health problems in time of natural disaster. The objectives of this project are to determine and describe remote sensing standard operating procedures for public health assistance during disaster relief operations which will aid the agencies and organizations involved in disaster intervention. We plan to test the validity of this technology by applying it in a post-disaster situation (if such a disaster occurs in our space and time frame) and comparing it, where possible, to existing methods of gathering information. The important variable here is time since existing methods do eventually accumulate necessary data. This research is analogous to a therapeutic trial in that we are testing one "vaccine"--remote sensing--against other "vaccines"--existing approaches.

2. Disasters and Public Health. Disasters interrupt systems necessary to maintain the public health. It is necessary not only to reestablish all the interrupted systems on which the protection of health of a community relies; but, to manage the potential and real public health problem during the period of reestablishment. The activities involved in doing this may seem from one perspective to have no relation to health, but from another perspective they are the underpinnings on which the health of a community depends. Two

points need to be made clear: (1) Public health activities are broad-spectrum, that is, they are carried out on a societal as well as on an individual level, and (2) the emphasis in public health is on prevention, not cure. Medical care per se or effective treatment of illness, it has been argued, "has little, if any, effect on the health of a community" (Stallones, 1972). In fact, for some diseases successful treatment may even increase the burden of illness in the community. From a community health perspective, medical care or treatment of illness "represents the failures of community health" (Stallones).

When we consider prevention in relation to natural disasters we do not mean to imply prevention of the event since with most types of natural disaster this is not yet possible. This research emphasizes a preventive approach to the effects of disasters and specifically to post-disaster problems that relate to public health concerns during the emergency phase of relief. It is generally agreed upon that there are three phases of relief activities following a disaster. The first is the emergency phase during which persons impacted by the disaster are rescued and first aid and other medical care are administered. This phase is followed by the recovery period during which time residents of the community assess their situation and work toward reestablishing a stable way of life. Public health concerns at this time may revolve around treatment of illness which might have occurred as either a result of the disaster, a result of actions taken during

the emergency phase, or other factors such as the prevalence of certain disease types pre-disaster. The final phase deals with restoration and rehabilitation of the community to pre-disaster conditions and may take from weeks to years depending on the type of disaster and economic resources available to the community.

Concerns of the emergency phase may range from reestablishing transportation routes into an area cut off by a disaster to the identification of environmental factors which foster disease occurrence. In a disaster context, medical care, while remedial, may also come under the umbrella of public health coordination activities. Public health in the context of disaster relief encompasses the total scope of community health, namely, all the community efforts influenced by the medical arts and sciences, applied to the prevention of disease, protection of life, and the promotion of the well being and efficiency of man, inclusive of the physical, mental, and social aspects.

3. End Product: Manuals for disaster managers and remote sensing personnel. At this point, two manuals or suggested operations guides are planned--one a technical guide for data gathering and analysis, and another describing potential applications of the data gathered. One guide will be written for agency personnel and will outline by public health problem the functions and tasks involved in disaster relief. Evidence exists to show that inappropriate actions on the part of disaster relief managers have frequently

contributed to unnecessary mortality, morbidity and inefficient use of resources (Center for Disease Control, 1974). Mismanagement problems are most often caused by a lack of knowledge and/or skill of the work functions required to manage disaster relief. Tasks which can be accomplished or aided by remote sensing will be identified. This guide will be unique in two respects: (1) It will document functions and tasks which are nowhere clearly outlined and so will impart knowledge to those who cannot rely on experience as well as specifying in diagramatic form these same tasks for experienced personnel, and (2) It will suggest a novel application of an improved technology for solving a serious problem.

The second guide will be directed to a remote sensing specialist. It will outline the tasks to be performed by an image analyst and will include both preplanning and post-disaster activities. The procedures used to develop this manual will be similar to those used in developing the manual for disaster managers. Specifically this will involve diagramming the tasks of the remote sensing specialist and the information sources required to perform these tasks.

B. HYPOTHESES

We have formulated the following hypotheses:

1. Remote sensing technology can supply data faster, more completely, and more accurately than current methods.
2. A manual can prepare a remote sensing technician to

carry out the duties and functions demanded of him in applying remote sensing technology to a natural disaster.

3. Using this method of intervention, we can assist to reduce management errors in a disaster caused by information delay.

Testing the difference in quality of data collected at comparable time intervals from current methods and from remote sensing would ideally require that the two collection systems were used simultaneously and then compared. This could be done if an actual disaster were to occur in the time frame of the current project. A second testing procedure would be to make a retrospective study of the time required for collection and its quality by interviewing persons recently involved in a disaster. This information could be compared to the estimate derived from a simulation whereby remote sensing is used to provide the same data.

The effectiveness of the manual as a training guide for a remote sensing technician will be tested either in a pilot test coinciding with an actual disaster or in a simulation without a disaster. This would consist of utilization of the manual by a remote sensing expert to collect the data and provide observational information needed to deal with the problem areas on the flow charts. Duties would involve such things as flight planning, resource gathering, and photo interpretation. Such a test could be done at the time of a

disaster (with or without input to the decision-making system), or a simulation could be performed without a disaster.

Testing the third hypothesis is very difficult and will not be undertaken since it is virtually impossible to conduct a controlled exposure validation. This would entail having the same disaster strike two similar communities with equal intensity at the same time and exposing one to remote sensing while using the other as a control community without the use of remote sensing. Additionally, we have no mechanism whereby decision-makers would be limited to utilize data from remote sensing sources. However, we will demonstrate its usefulness by the manual which presents the problems in flow chart form to encourage such utilization.

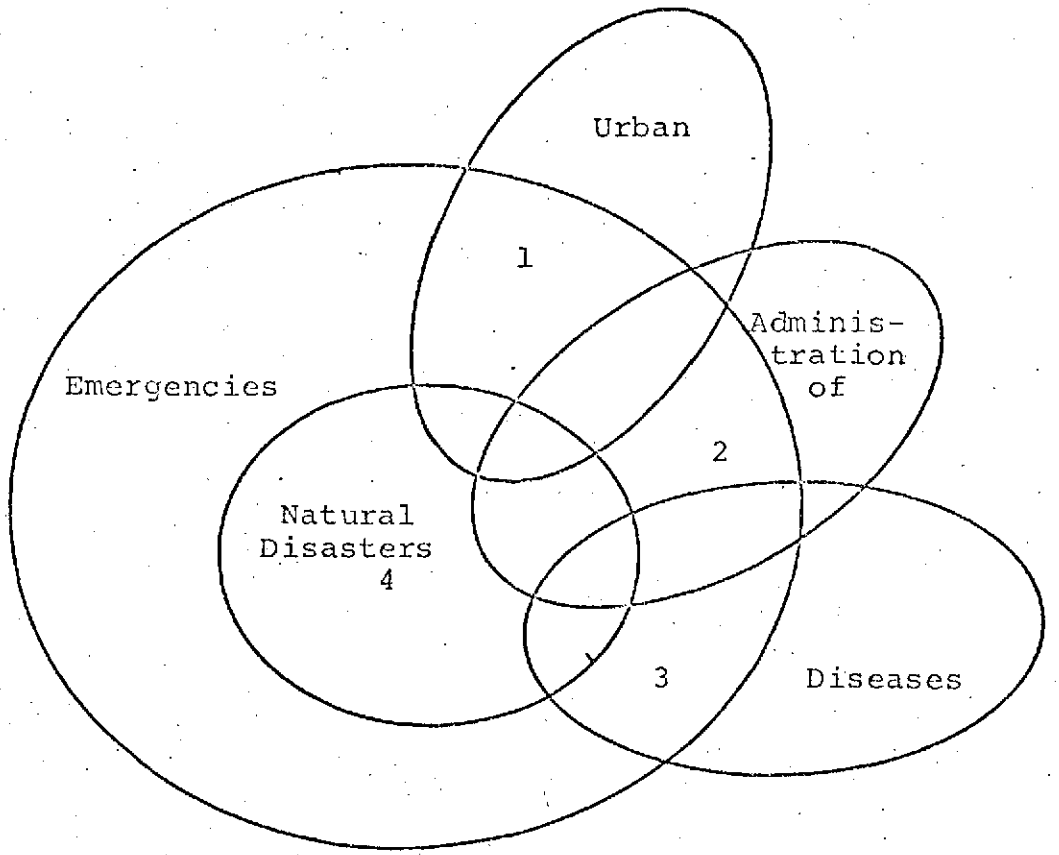
C. STEPS

This section details the steps which have been taken and those which are planned to complete the research described above.

1. Literature Review. Approximately the first three months of the investigation were devoted to reviewing the literature. A comprehensive literature search and review of two topic areas, disasters and remote sensing of the environment, was carried out. A list of indices and abstracts which were searched in connection with the project appears in Appendix A. A bibliography containing 167 documents examined and used is included in Appendix B. In addition, a

computer search was made through the National Library of Medicine (NLM/MEDLINE). Diagram 1 portrays the four areas of literature that were cross-referenced in the search. Table 1 shows the number of references retrieved from each area and the approximate number which were relevant to this project.

DIAGRAM 1



The types and extent of past disasters were examined in order to determine the public health and medical problems related to various types of disasters. (See Appendix C for examples of these tabulations.) It was found that while

TABLE 1

REFERENCES RETRIEVED FROM MEDLINE

SEARCH BY TOPIC AREA

	Number Cited	Number Applicable
Administration of Natural Disasters	278	15
Diseases and Natural Disasters	81	8
Natural Disaster Articles	300	35
Urban Population and Natural Disasters	51	1

most publications in the disaster literature emphasized the need to be aware of possible public health problems, few publications enumerated the problems which developed or might develop. In fact only four studies were epidemiological follow-up studies of a disaster (Gilbert et al, 1973; Manos, 1958; Saha, 1972; and Sommer and Wiley, 1972). The literature search then focused on the environmental disruptions most likely to occur in disasters with emphasis on those which had visible physical surrogates. The damage characteristics which might be surrogates for public health problems were identified. (See Appendix D.) The public health implications of these environmental disruptions were then analyzed in terms of the community as a whole and in terms of specific disease outcomes which might result. Diseases were described according to their mode of occurrence, area of endemicity, and control and prevention.

It was also found that the work functions required to effectively manage disaster relief were nowhere clearly outlined. This situation proved to be an unanticipated obstacle since we had assumed that the tasks to be performed in relief operations were already specified. It has already been noted that disaster mismanagement caused by lack of knowledge and/or skill has contributed to unnecessary mortality, morbidity, injury and inefficient use of resources. Before a plan for effective disaster management can be devised, however, the work functions which need to be performed in disaster relief must be delineated.

The staff also searched for literature concerning the application of remote sensing to disasters. Only three studies examined the potential utility of remote sensing in disasters, and only one applied it retrospectively to post-disaster activities (Rapid City Flood, 1973; Garafalo and Wobber, 1974; Wobber, 1971).

2. Interviewing. Disaster-responding agencies in the state of Texas were identified at all levels of government, and contact was established between them and the project staff. Prior to interviewing people in the agencies, a letter and two lists of questions were sent to them. (See Appendix E for the letter, questions, and list of people interviewed.) It was hoped that this procedure would facilitate discussion since most agency personnel had not considered the idea of using remote sensing technology in disaster relief activities. The major difficulty in conducting these interviews was the unexpected one already mentioned, i.e., the absence of an explicit specification of disaster relief work functions. It was possible, then, to talk only in generalities about how relief activities are carried out. These interviews served, however, to acquaint directors and personnel in Texas agencies with this project and to acquire cooperation in testing this application of remote sensing.

Included among the agencies contacted were the Federal Disaster Assistance Administration (FDAA), State of Texas Emergency Operating Center (EOC), Galveston EOC, Houston EOC

and the Regional Red Cross. Appendix F contains organizational diagrams and maps of Federal disaster regions and the Texas state regions and agencies responding to disasters.

3. Flow diagraming. As mentioned, disaster plans have been organized around functions that have not been made explicit. SOP's when available usually detail tasks by agencies rather than by functions to be accomplished. This approach leads to fragmentation and duplication of effort since restoring certain systems following a disaster may cross-cut several agencies. For example, checking and restoring the water system and supplying water may involve the Division of Engineering Services which is responsible for checking and repairing the system, the Health Department which is required to test for contamination and the Red Cross which is charged with distributing water to areas where the supply has been cut off. A more wholistic approach to disaster management would be to diagram work functions across agency boundaries and this was the approach adopted.

Disaster relief activities were divided into six general areas of concern: medical attention, water, waste disposal, transportation, food, and shelter. Flow diagrams of the major disaster relief decisions and inputs were made to facilitate discussions with interviewees. It was observed in early interviews that their lack of experience and knowledge regarding their disaster relief functions led to a defensive stance and hindered information-gathering. The use of the flow diagrams put the burden of presentation on the research

staff while the interviewees took the role of experts to criticize or comment on the diagrams. These diagrams elaborated within functions the decisions and tasks required to manage relief activities. (See Appendix G for the flow diagrams.) Problem-solving contingencies were elaborated within a decision-making framework identifying what has to be done to "solve" a disaster problem. Sixteen interviews were conducted with agency personnel who are responsible for managing relief activities in Houston and in Galveston to verify the accuracy of the diagrams (Appendix H). Revisions were made following suggestions of disaster managers.

These diagrams are linear, that is, various tasks are ordered sequentially according to priorities. However, relief activities for the most part have a web-like structure in which many things go on concurrently. Therefore it must be kept in mind that the starting point for all the diagrams is either pre-disaster planning or immediately post-disaster. In addition, tasks on some of the diagrams may go on simultaneously. For example, repair of the water facilities may go on concurrently with distribution of water. How remote sensing can aid these work functions will be discussed in the following section.

4. Remote Sensing. Based on the literature review a list of environmental disruptions which might serve as surrogates for health problems was developed. This list was checked by an image analyst to identify which items could be

detected from aerial photography at a given scale and film type. Additions were made to the list based on a photographic analysis of two previous disasters--the Celia hurricane and the Managua earthquake.

Using the flow diagrams discussed in the previous section, the specific observations needed to accomplish tasks within the six functions were listed. A remote sensing technician will review these observations to confirm if they can be made using remote sensing. Many of them overlap with the environmental disruptions identified as part of the literature review. Depending on the remote sensing technology employed and on the feasibility of making these observations, a time frame for delivering the information required within the six disaster management functions will be suggested. A checklist will be devised to facilitate the interface of relief activities and remote sensing.

Attention was also given to outlining remote sensing systems which would be adaptable to disaster situations. Camera systems, film and filter combinations, aircraft, scales of photography and other variables were examined. Alternatives to aerial photography which also may be defined as remote sensing are being considered such as videotape systems and a trained observer/recorder in low altitude aircraft. Recording could be directly on maps or on audiotape.

The advantage to both of these alternatives is that there is no time lost for processing film. An additional advantage to the latter is that many communities may already have trained observers available to them in the form of traffic control or news personnel. The advantage to using aerial photography on the other hand is that it provides a permanent record of the disaster area which can be used not only in part of the emergency relief phase but also in the later phases of recovery and of restoration. The disadvantages of aerial photography are (1) the time lag between photographing the disaster and processing the film, (2) the preplanning necessary to execute a flight, e.g. develop a flight plan, acquire appropriate film type, equipment, etc., and (3) the necessity of having access to a trained image analyst. All systems require some preplanning to the extent that maps of the area denoting the location of various important facilities must be available. The selection of a remote sensing system will depend to a large extent on the resources of the community wishing to implement the plan.

5. Attend disaster (if one occurs). In order to gain insight into community priorities, reactions, and problem areas, the staff members will take part, as on-site observers, in a disaster relief operation. They will further view the operation of the Texas Defense and Disaster Relief Council to determine the possible additional roles remote sensing might play in disaster assessment. Experience with an

actual disaster will provide the basis for a more complete procedures manual. Procedures for observation and interviewing are being planned.

Remotely sensed data will be gathered. Provisions have been made whereby the State Coordinator of the State of Texas Emergency Operating Center, through his official channels, can request that a disaster relief reconnaissance mission be flown by personnel at Bergstrom Air Force Base (Austin). Arrangements have been made so that the gathering of remotely sensed data will begin within a maximum of two (2) hours after the call for assistance has been received assuming weather conditions permit. This will allow us to obtain time estimates on the acquisition of data. Provisions will be made for acquisition of a photo interpreter.

6. Procedure Used to Develop Manuals.

A. First draft of manuals

1. Preparation

a. Literature review

b. Interviewing

2. Flow diagramming of functions

a. Decision-making tasks

b. Remote sensing tasks

3. Verification of diagrams with disaster managers

4. Write up of discussions on

a. Cross-cutting agency functions and

how diagrams may be used to synchronize them

b. Remote sensing expert's duties and functions.

B. Review and Evaluation

1. Agency review
2. Consultant review
3. Test of efficiency for remote sensing

7. Plan Evaluation. An evaluation and analysis of the project will be carried out along two lines: (1) the procedures in the manuals will be assessed by review for clarity and for impressions of feasibility; (2) tests will be carried out to see if the remote sensing manual can effectively prepare a remote sensing technician to supply data needed by disaster managers. To accomplish the first goal of evaluating the utility of the concepts and procedures in the manuals, disaster managers and consultants will critique them. Evaluation of the teaching effectiveness of the manual will be made by a pre-test and post-test administered to an image analyst. Photographs of a disaster will be analyzed both before and after the photo interpreter has studied the manual. The data and its organization and presentation will be compared.

In order to evaluate the usefulness of the remote sensing approach to the alleviation of public health problems following a disaster and to ascertain whether the maximum

information was extracted from the imagery, a detailed retrospective analysis of the photography compared with details gathered through existing means will be performed if possible. Validation of the usefulness of remote sensing which is outside the scope of this project would be to conduct a follow-up, epidemiological study correlating the public health problems which actually occurred in the disaster and those predicted from the photographic surrogates, taking into account preventive measures. This would involve collecting health data from the local agencies responsible for health care in the community such as the Health Department and various hospitals and from emergency relief organizations such as the Red Cross. Recommendations will ultimately be made regarding this application of remote sensing technology in meeting the public health needs of a disaster-stricken community. If time and resources permit, a second pilot study on a different type of disaster will be conducted.

REFERENCES

Center for Disease Control, U.S. Dept. of Health, Education, and Welfare
1974 "Disaster Mismanagement: A Study of the Problems and its Causes." (July).

Garofalo, D. and Wobber, F. J.
1974 "The Nicaragua Earthquake: Aerial Photography for Disaster Assessment and Damage-Avoidance Planning," Photographic Applications (January).

Gilbert, D. N., et al
1973 "Microbiologic Study of Wound Infections in Tornado Casualties," Archives of Environmental Health 26 (March), pp. 125-130.

Manos, N. E.
1958 "The Tornado as an Epidemiological Research Tool," Bulletin of American Meteorological Society 39 (September), pp. 460-468.

Rapid City, South Dakota Flood
1973 "Remote Sensing for Evaluating Flood Damage Conditions" (June 9).

Saha, A. L.
1972 "Epidemiological First Aid and Follow Up in Natural Calamities," Indian Journal of Public Health XVI (October), pp. 156-159.

Sommer, A. and Wiley, W. H.
1972 "East Bengal Cyclone of November 1970: Epidemiological Approach to Disaster Assessment," Lancet 1 (May), pp. 1029-1036.

Stallones, Reuel A.
1972 "Environment, Ecology, and Epidemiology," WHO Chronicle 26(7) (July), p. 294.

Wobber, Frank J.
1971 "Photography of the Peru Earthquake: A Preliminary Analysis," Photographic Applications in Science, Technology and Medicine (March) pp. 20-29.

APPENDICES

LIST OF APPENDICES

APPENDIX A

INDICES, ABSTRACTS, AND BIBLIOGRAPHIES

An Annotated Bibliography on Disaster and Disaster Planning (Disaster Research Center)
Applied Science and Technology Index
Biological Abstracts
Congressional Index Service
Disaster Research Center Publications
DCPA Publications
Engineering Index
Excerpta Medica - Environmental Health and Pollution Control
Excerpta Medica - Public Health, Social Medicine and Hygiene
Government Reports Announcements
Governmentwide Index to Federal Research and Development Reports
Monthly Catalogue - United States Government Publications
N.Y. Times Index
Oceanic Index
Reader's Guide to Periodical Literature
Science Citation Index
Selected Water Resources Abstracts
Water Resources Abstracts
Water Resources Research Catalogue

Indices Of:

American Journal of Epidemiology
American Journal of Public Health
American Journal of Sociology
American Sociological Review
British Journal of Sociology
Contemporary Sociology
Human Organization
Journal of World Meteorological Association
Medical Care Review
Monthly Weather Review
Sociology
Sociology and Social Research
Urban Review
Urban Studies

APPENDIX B

BIBLIOGRAPHY

Adams, David
1970 "The Red Cross: Organizational Sources of Operational Problems," American Behavioral Scientist, 13, No. 3, (January, February), p. 393.

Advisory Committee on the Application of Science and Technology
1972 to Development, The Role of Science and Technology in Reducing the Impact of Natural Disasters on Mankind. New York: United Nations.

Aguirre, Ernesto Domingues
1963 "Hurricanes of the Gulf of Mexico," Weatherwise, (October), p. 223-224, 252.

Allenbaugh, Gerald E.
1972 "Emergency Radios Restore Order to Chaos," Hospitals, J.A.H.A., Vol. 46, (January), p. 60-65.

Alter, Amos J.
1970 "Environmental Health Experiences in Disasters," AJPH, Vol. 60, (March), p. 475-480.

American Red Cross
1966 "Disaster Action," Chapter in Manual A, American National Red Cross.

Amsbury, D.L.
1970 Peruvian Earthquake Damage Assessment. Houston: Manned Spacecraft Center, (July).

Anderson, Alan Jr.
1973 "Earthquake Prediction: The Art of the State," Saturday Review of the Sciences, (February), p. 25-33.

Anderson, William A.
1969 "Disaster Warning and Communication Processes in Two Communities," Journal of Communication, Vol. 19, (June), p. 92-104.

Archibald, H.M.
1970 "The Role of the National Health Service in Civil Disasters," Trans. Soc. Occup. Med., 20, p. 17-27.

Assar, M.
1971 Guide to Sanitation in Natural Disasters, Geneva: World Health Organization.

Bennet, G.
1970 "Bristol Floods, 1968," Br. Med. J., 3, (August), p. 454-458.

Braverman, S.
1971 "California Quake," American Journal of Nursing, Vol. 71, (April), p. 0-12.

Breman, J.G.
1970 "Fire and Flood," Lancet, Vol. 2, (November), p. 1129.

Brouillete, John R.
1970 "The Department of Public Works: Adaptation to Disaster Demands," American Behavioral Scientist, Vol. 13, No. 3, (January-February), p. 369.

Casberg, M.A.
1954 "Medical Organization in National Catastrophe," JAMA, Vol. 154, No. 6, (February), p. 501-506.

"Causes of Catastrophe," NEJM, Vol. 278 (October), p. 886.
1968

Chaine, P.M.
1973 "Glaze and Its Misery: The Ice Storm of 22-23 March 1972, North of Montreal," Weatherwise, (June), p. 124-127.

Chen, L.C. (Ed.)
1973 Disaster in Bangladesh. New York: Oxford University Press.

Clark, Gilbert B.
1966 "The Hurricane Season of 1965," Weatherwise, (February), p. 13.

Curry, George J.
1954 "The Flint Tornado," Bulletin of the American College of Surgeons, Vol. 39 (May-June), p. 125-126.

Curry, W.
1969 "Camille Revisited. A Critique of Community Response to a Major Disaster," Hospitals, Vol. 43, No. 21, p. 36a-36d.

Daniels, R.S.
1973 "Governance and Administration of Human Services in Urban Low-Income Communities," AJPH, Vol. 63, (August), p. 715-720.

DeAngelis, Richard M.
1969 "Enter Camille," Weatherwise, (October), p. 173-180.

Defense Civil Preparedness Agency
1973 "Natural Disaster Operations Planning for Slowly

Developing Disasters, Guide," Field Test Review Draft, (March).

Defense Civil Preparedness Agency
1973 "Natural Disaster Operations Planning for Slowly Developing Disasters," Vol. II, Field Test Review Draft (March).

Defense Civil Preparedness Agency
1973 "Natural Disaster Operations Planning for Slowly Developing Disasters," Vol. III, Field Test Review Draft, (March).

Demerath, N.J. and Wallace, A.F.C.
1957 Human Adaptation to Disaster, special issue of Human Organization (Summer).

Department of Defense, Office of Civil Defense
1968 In Time of Emergency: A Citizen's Handbook on Nuclear Attack and Natural Disasters, (March).

Devancy, John F.
1972 Organizing the Locality for Emergency Operations. For the Department of Defense, (April).

Dightman, R.A.
1964 "Montana Flood Month - June, 1964," Weatherwise, (August).

"Disaster Planning: An Unexercised Responsibility," NEJM,
1968 Vol. 278, (October), p. 847-848.

Division of Defense and Disaster Relief
1970 Disaster Statistics and Functional Chart of State Organization for Emergency Operations (Texas). Texas Department of Public Safety.

Division of Defense and Disaster Relief.
1971 Texas Tornadoes (map).

Drabek, Thomas E.
1970 "Methodology of Studying Disasters: Past Patterns and Future Possibilities," American Behavioral Scientist, Vol. 13, No.3, (January-February), p. 331.

Drabek, Thomas and Haas, J.E.
1969 "How Police Confront Disaster," Trans-Action, Vol. 6, (May), p. 33-38.

Dynes, Russell R.
1970 "Organizational Involvement and Changes in Community Structure in Disaster," American Behavioral Scientist,

Vol. 13, No. 3 (January-February), p. 430.

Dynes, Russell R.
1969 Organized Behavior in Disaster, Analysis and Conceptualization for Office of Civil Defense, Office of Secretary of the Army, Washington, D.C. Disaster Research Center Monograph Series, No. 3, (April).

Dynes, Russell R.
1966 "Theoretical Problems in Disaster Research," Bulletin of Business Research, Vol. 41, No. 9, (September).

Dynes, R.R. and Quarantelli, E.L.
1972 "When Disaster Strikes...," Psychology Today, Vol. 5, No. 9, (February), p. 66-70.

Dynes, Russell R. and Quarantelli, E.L.
1966 "Effects of Disaster on Community Life," "Function of an Organization Under Stress," Proceedings of Seminar on Family Agencies Role in Disaster, Canadian Department of National Health and Welfare, (November 14-17, 3-6, and 7-11).

Dynes, R.R., E.L. Quarantelli, and G.A. Kreps
1972 "A Perspective on Disaster Planning," Disaster Research Center, Report Series No. 11, (June).

Dynes, R.R. and D.E. Wenger
1971 "Factors in Community Perception of Water Resources Problems," Water Resources Bulletin, Vol. 7, No. 4, (August), p. 644-651.

Earth Science Curriculum Project
1967 Investigating the Earth. Boston: Houghton Mifflin Co.

"Eleven Tornadoes or Tornadic Systems of Significance in 1964,"
1965 Weatherwise, (February), p. 27.

Emergency Operations Plan for the City of Alice, Texas.
1972 (October 9).

Environmental Science Services Administration
1969 "Floods and Flood Warnings," U.S. Dept. of Commerce, Washington, D.C., p. 335-345.

Environmental Science Services Administration
"Some Devastating No. Atlantic Hurricanes of the 20th Century," U.S. Dept. of Commerce.

Faich, Gerald
1973 "Epidemiologic Surveillance and Immunizations Following the 1972 Managua Earthquake," APHA Session

on Epidemiologic Responses to Disaster, San Francisco, (November 7).

Fairley, J.
1969 "Mass Disaster Schemes," Brit. Med. J., Vol. 4, (November), p. 551-553.

Fechtel, E.J.
1973 "How St. Mary's Hospital, Athens, Ga. Handled a Recent Tornado Disaster," Hosp. Prog., Vol. 54, (August), p. 38.

Federal Committee for Meteorological Services and Supporting
1973 Research, Federal Plan for Natural Disaster Warning and Preparedness. U.S. Department of Commerce, (June).

Feris, C.
1970 "The Tornado at Kent, Washington, on 12 December 1969," Weatherwise, (April), p. 74-77.

Frank, Neil L.
1965 "The 1964 Hurricane Season," Weatherwise, (February), p. 19.

Friedman, Jules D.
1968 "Infrared Sensing of Active Geologic Processes," Proc. Remote Sensing of the Environment, p. 787-820.

Friedsam, H.J.
1960 "Older Persons as Disaster Causalities," Journal of Health and Human Behavior, Vol. 1-2, p. 269-272.

Fujita, T.T.
1973 "Tornadoes Around the World," Weatherwise, (April), p. 56-62, 78-83.

Fujita, T.T.
1970 "The Lubbock Tornadoes: A Study of Suction Spots, Weatherwise, (August), p. 161-165, 172-73.

Garb, Solom and Eng, Evelyn
1969 Disaster Handbook, 2nd edition. New York: Springer Publishing Co., Inc.

Garofalo, D. and F.J. Wobber
1974 "The Nicaragua Earthquake: Aerial Photography for Disaster Assessment and Damage-avoidance Planning," Photographic Applications, (January).

Gilbert, David N., et. al.
1973 "Microbiologic Study of Wound Infections in Tornado

Casualties," Arch. Environ. Health, Vol. 26 (March), p. 125-130.

Gutierrez, Celendonio
1972 "A Narrative of Human Response to Natural Disaster: The Eruption of Paricutin," Environmental Quality Note 07, Texas A & M University, (July).

Haas, J.E. and T. Drabek
1970 "Community Disaster and System Stress: A Sociological Perspective," in Social and Psychological Factors in Stress, edited by J.E. McGrath. New York: Holt, Rinehart, and Winston, p. 264-286.

Hammond, Allen L.
1973 "Earthquake Prediction II; Prototype Instrumental Networks," Science, (June 1), p. 940-941.

Hammond, Allen L.
1973 "Hurricane Prediction and Control: Impact of Large Computers," Science Research News, (August 17), p. 643-645.

Herbert, Paul J.
1973 "The Hurricane Season of 1972," Weatherwise, (February), p. 15-21.

Herbert, Paul J.
1967 "The Hurricane Season of 1966," Weatherwise, (February), p. 17.

Hewitt, K. and I. Burton
1971 The Hazardousness of a Place. Toronto: University of Toronto Press.

Hewitt, Kenneth
1969 A Pilot Survey of Global Natural Disasters of the Past Twenty Years. Toronto: University of Toronto Press.

Hight, D., J.T. Blodgett, E.J. Croce, E.O. Horne, J.W. McKoan,
1956 and C.S. Whelan, "Medical Aspects of the Worchester Tornado," New England Journal of Medicine, Vol. 254, No. 6, (February), p. 267-271.

History of Hurricane Occurrences Along Coastal Louisiana -
1961 Hurricane Study. U.S. Army Corps of Engineers (December 29).

Hocking, F.
1970 "Extreme Environmental Stress and Its Significance for Psychopathology," Am. J. of Psychotherapy. Vol. 24,

(January), p. 4-26.

Hollis, Thomas L. and Barbara W. Sapp
1972 "The Hospital as an Emergency Center: Disaster Planning," Hospitals, Vol. 46, (May 1), p. 38-41.

Holloway, R.M.
1971 "Medical Disaster Planning, I and II," New York State Journal of Medicine, Vol. I, No. 71 (March 15), p. 692-694 and Vol. II, No. 71, (March 1), p. 591-595.

Holloway, R.M. and J.E. Stolfi
1972 "Mobile Vans as Disaster Scene Emergency Rooms," Hospitals, Vol. 46, (December 1), p. 43-47.

Housley, C.E.
1972 "Assignment Specifications Facilitate Disaster Planning," Hosp. Prog., Vol. 53 (March), p. 78-81.

Hurricane Camille - August 12-22, 1969.
1970 Mobile: U.S. Army Corps of Engineers, (May).

Hurricane Camille - After Action Report. August 17-18, 1969.
1970 Mobile: U.S. Army Corps of Engineers (February).

Institute of Behavioral Science
1973 Assessment of Research on Natural Hazards. Conference, Working Paper No. 28. (October 15), Invitational Conference on Natural Hazards Research.

Jaworski, Hannibal
1954 "The Waco Tornado," Bull. of the Am. College of Surgeons, Vol. 39, (May-June), p. 129-132.

Johnson, J.E.
1970 "Tornado as Teacher," Lessons learned in caring for tornado victims lead to revision of one hospital's disaster plan, Hospitals, Vol. 44, (March 1), p. 40-42.

Jorgensen, Jerome C.
1969 "The O.R. and Disaster," Hospitals, Vol. 43, (December), p. 102-105.

Kates, Robert W., J. Eugene Haas, Daniel J. Amaral, Robert A.
1973 Olson, Reyes Ramos, and Richard Olson, "Human Impact of the Managua Earthquake Disaster," Working Paper No. 23, Science, Vol. 182, No. 981 (December).

Kennedy, Will C.
1970 "Police Departments: Organization and Tasks in Dis-

aster," American Behavioral Scientist, Vol. 13, No. 3, (January-February), p. 354.

Kennedy, W.C., M. Brooks, and S. Vargo
1970 "Police in Disasters," Survival, Vol. 6, No. 3, (Fall), p. 2.

"Killer Twisters: Challenge to Emergency Medical Services,"
1971 J. Miss. State Med. Assoc., Vol. 12, (September), p. 493-495.

Kogel, Marcus D.
1950 "Medical Planning for Disaster in the City of New York," New York Medicine, (November 20).

Kunreuther, Howard C.
1966 "Migration Patterns Following a Disaster," Institute for Defense Analysis, Economic and Political Studies Division, (September).

Kunreuther, Howard C.
1966 "Problems of Information and Communication in Natural Disasters," Institute for Defense Analysis, Economic and Political Studies Division, (September 15).

Kunreuther, Howard C.
1966 "Short Run Supply and Demand Problems in Natural Disasters," Institute for Defense Analysis, Economic and Political Studies Division, (September).

Leake, C.D.
1947 "Military Principles Applied to a Civilian Disaster," Texas Hospitals, Vol. III, (October), p. 7.

"List of Natural Disasters for 1972."
1972 1973 Britannica Book of the Year. William Benton, Publisher.

Lounsbury, John F. and Lawrence Ogden
1969 Earth Science. New York: Harper and Row.

Ludlum, D.M.
1969 "The Snowfall Season of 1967-68," Weatherwise, (February), p. 26-31.

McLerran, James H. and Joseph O. Morgan
1965 "Thermal Mapping of Yellowstone National Park," Proc. Remote Sensing of the Environment, p. 517-522.

Maher, Thomas F.
1954 "Civil Defense Agency: A Critical Analysis of the Medical Problems of Three Recent Major Disasters,"

New England J. of Medicine, Vol. CCLI, (October 14), pp. 677-678.

Manos,N.E.
1958 "The Tornado as an Epidemiological Research Tool," Bulletin American Meteorological Society, Vol. 39, (September), p. 460-468.

Miller, A. and J.C. Thompson
1970 Elements of Meteorology. Columbus: Charles E. Merrill Publishing Co.

Mitchell, H.H.
1972 Guidelines for the Control of Communicable Diseases in the Post-attack Environment. Washington, D.C.: Defense Civil Preparedness Agency.

Moore, Harry E.
19? Waco-San Angelo Disaster Study. Report of Second Year's Work. Austin, Texas: Dept. of Sociology, University of Texas.

Moore, Harry E., et. al.
1964 "... and the Winds Blew," The Hogg Foundation for Mental Health. Austin: University of Texas.

Myers, Victor I., et. al.
1972 Remote Sensing for Evaluating Flood Damage Conditions. The Rapid City, South Dakota Flood. Remote Sensing Institute, South Dakota State University, Brookings.

National Oceanic and Atmospheric Administration
1972 "Climatological Data - National Summary," U.S. Dept. of Commerce, Annual, Vol. 23, No. 13.

National Oceanic and Atmospheric Administration
1971 "Hurricane - the Greatest Storm on Earth," Washington, D.C.: U.S. Government Printing Office.

Nelson, J.W.
1969 "Micro Aspects of Manhattan Tornado in Kansas on 8 June, 1966," Weatherwise, (June), p. 113-117.

Nichaman, Milton Z.
1973 "Evaluation of Nutritional Status in Times of Disaster," Presented at the 101st Annual Meeting of the APHA, Epidemiologic Responses to Disaster Section, (November 7).

"North Atlantic Tropical Cyclones, 1971,"
1972 Monthly Weather Review, Vol. 100, No. 4, (April), p. 258.

"Northeast Pennsylvania Hospitals Found Many Ways to Cope With
1972 Flood; One Moved to Misericordia College," Modern Hospital, (August), p. 26.

"Obstacles to Disaster Planning,"
1972 Hospitals, Vol. 46, No. 45, (January 16).

Parr, Arnold R.
1970 "Organization Response to Community Crises and Group Emergence," American Behavioral Scientist, Vol. 13, No. 3 (January-February), p. 423.

Parr, Arnold R.
1969 A Brief View on the Adequacy and Inadequacy of Disaster Plans and Preparations in Ten Community Crises. Disaster Research Center, Dept. of Sociology, Ohio State U., (June).

Peavy, James E.
1970 "Hurricane Beulah," AJPH, Vol. 60, No. 3, (March), p. 481-484.

Poultney, N.E.
1973 "The Tornado Season of 1972," Weatherwise, (February), p. 22-27.

Prevention and Treatment of Severe Malnutrition in Times of
1951 Disaster. Technical Report Series, No. 45. World Health Organization, (November).

Prosser, Norman E.
1964 "Aerial Photographs of a Tornado Path in Nebraska, May 5, 1964," Monthly Weather Review, Vol. 92, No. 12, (December), p. 593-598.

Quarantelli, E.L.
1972 Problems and Difficulties in the Use of Local EOC's in Natural Disasters. Working Paper #43, Disaster Research Center, Department of Sociology, Ohio State U., (May).

Quarantelli, E.L.
1970 "A Selected Annotated Bibliography of Social Science Studies on Disasters," American Behavioral Scientist, Vol. 13, No. 3, (January-February), p. 452.

Quarantelli, E.L. and R.R. Dynes
1967 "Operational Problems of Organizations in Disaster," 1967 Emergency Operations Symposium, edited by Robert Brictson, Santa Monica: System Development Corp., p. 151-175.

Quarantelli, E.L. and R.R. Dynes
1973 "When Disaster Strikes," New Society, Vol. 23, (January 4), p. 5-9.

Rainey, Charles T.
1972 Natural Disaster Operations Planning. Washington, D.C.: Office of Civil Defense, Office of Secretary of the Army.

Rennie, Drummond
1970 "After the Earthquake," Lancet, Vol. 2, (October 3), p. 707-707.

Roth, Robert
1970 "Cross Cultural Perspectives on Disaster Response," American Behavioral Scientist, 13, No. 3, (January-February), p. 440.

Sachs, Abner and Janet D. Kiernan
1972 Natural Disasters Operations Planning for Slowly Developing Disasters, Vol. I. Institute for Defense Analysis Program Analysis Division, Paper P-884.

Sadowski, Alexander
1966 "Tornadoes With Hurricanes," Weatherwise, (April), p. 71-75.

Saha, A.L.
1972 "Epidemiological First Aid and Follow-up in Natural Calamities," Indian Journal of Public Health, Vol. XVI, No. 4, (October), p. 156-159.

Schaffer, Ruth C. and Earl Cook
1972 "Human Response to Hurricane Celia," Texas A & M University, Environmental Quality Note 08, (July).

Schmitt, N.
1970 "Flash Flood at Trail, B.C. 1969," Canad. J. Pub. Health, Vol. 61, (March-April), p. 104-111.

Scholz, Christopher H., et. al.
1973 "Earthquake Prediction: A Physical Basis," Science, Vol. 181, No. 4102, (August 31), p. 803-810.

Schultz, Robert D.
1966 "The Coastal Population of the U.S. and Its Target Potential," Institute for Defense Analysis. Economic and Political Studies Division, (March).

Simpson, R.H.
1973 "Hurricane Prediction: Progress and Problem Areas," Science, Vol. 181, No. 4103, (September), p. 899-907.

Sims, John H. and Duane D. Baumann
1972 "The Tornado Threat: Coping Styles of the North and South," Science, Vol. 176, (June 30), p. 1386-1392.

Singer, S.F.
1970 "Will the World Come to a Horrible End?" Science, Vol. 170, (October 9), p. 125.

Sommer, Alfred
1973 "Epidemic Control in Times of Disaster: Smallpox in Post-war Bangladesh," paper presented at the American Public Health Association Annual Meeting, (November).

Sommer, Alfred and Wiley H. Mosley
1972 "East Bengal Cyclone of November 1970 Epidemiological Approach to Disaster Assessment," Lancet, Vol. 1, (May 13), p. 1029-1036.

Stannard, Burke
1971 Measures of Emergency. An Examination of Organization Response to Disaster. Study #1. Studies of Stressed Organization. Defense Research Analysis Establishment, Ottawa, Canada.

Strahler, Arthur N.
1972 Planet Earth: Its Physical Systems Through Geologic Time. New York: Harper and Row.

Strangway, D.W. and R.C. Homer
1965 "Infrared Geology," Proc. Remote Sensing of the Environment, p. 293-301.

Street, John H.
1973 "U.S. Government Role in Coordination of International Disaster Emergency Assistance," presented at the APHA Session on Epidemiologic Response to Disaster, San Francisco, (November 7).

Tannehill, Ivan Ray
1938 Hurricanes, Their Nature and History. Princeton, N.J.: Princeton University Press.

"Ten Outstanding Tornadoes of 1967"
1968 Weatherwise, (February), p. 24.

"Ten Years of NASA's Aerial Photography Available to Researchers,"
1974 Photographic Applications, (January).

Texas Almanac
1973 The Daily Morning News & State Industrial Guide 1974-1975. A.H. Belo Corporation.

Texas A & M University
1970 "What To Do After the Storm," Texas Agricultural Extension Service, J.E. Hutchison, Director, College Station, Texas.

Texas, State of
1968 Standing Operating Procedure. Austin, Texas: Dept. of Public Safety, (September), now under revision.

Texas Water Commission
1963 Floods in Texas: Magnitude and Frequency of Peak Flows. Bulletin #6311, (December).

Texas Water Development Board
1968 The Texas Water Plan, (November).

Treadwell, Mattie E.
1961 Hurricane Carla. Denton, Texas: Dept. of Defense Office of Civil Defense Region 5.

Trewartha, Glenn T.
1954 An Introduction to Climate. New York: McGraw Hill Book, Co., Inc.

Wade, Nicholas
1972 "Earthquake Research: A Consequence of the Pluralistic System," Science, Vol. 178, (October 6), p. 39-43.

Warheit, George J.
1970 "Fire Departments: Operations During Major Community Emergencies," American Behavioral Scientist, Vol. 13, No. 3, (January-February), p. 362.

Water Resources Council
1968 The Nation's Water Resources. The First National Assessment of the Water Resources Council.

Wilson, William L.
1951 "The Handling of Casualties," J. of the Kansas Med. Society, Vol. LII, (July), p. 319-325.

Wobber, Frank J.
1971 "Photography of the Peru Earthquake: A Preliminary Analysis," Photographic Applications in Science, Technology and Medicine, (March), p. 20-29.

World Almanac, 1974
1973 New York: Newspaper Enterprise Corp.

Yutzy, Daniel
1970 "Priorities in Community Response," American Behavioral Scientist, Vol. 13, No. 3, (January-February), p. 344.

APPENDIX B

LEGISLATION

The Disaster Relief Act of 1970.

Legislative History of Disaster Relief Act.

Chapter 58 of Title 42 of U.S. Code, 1970.

Chapter 54 of Title 42 of U.S. Code (1973) - latest section - amendment dealing with disaster relief.

Reorganization Plan #1 of 1973 - Nixon proposed to abolish Office of Emergency Preparedness.

Presidential Message to Congress, March 8, 1973 - disaster assistance and reference to new Disaster Assistance Act.

Executive Order 11725 - transfers functions of OEP to Department of Housing and Urban Development.

Presidential Message to Congress, September 10, 1973 - two specific plans for disaster relief.

"Summary of Federally-funded Resources Available to Victims of Disasters"

Federal Disaster Assistance Handbook, August, 1972.

Texas Disaster Act of 1973, Chapter 216, S.B. No. 786.

Executive Order - Dolph Briscoe, August 22, 1973, No. D.B.-6.

APPENDIX C

INDIVIDUAL NATURAL DISASTER REPORT*

Date and Duration	Type (name)	Location (total area involved)
Sept. 5-22, 1967	Beulah (most studied & best documented hurricane on record)	Lesser Antilles, Puerto Rico, Mexico, Texas

Types of Injuries		Types of Property Damage	Incidence of Disease
# injured	# killed	$ estimate	(types and extent)
8,000	18 (south Texas)	542 homes destroyed 23,000 homes damaged 513 small businesses destroyed public facilities one million $ other property loss one billion $ (as tornadoes) (115 - Texas Water Report and Texas Almanac) property and crop losses - extreme!	Used US Air Force spray planes to control potential mosquito problems.

Worst natural disaster recorded in Texas. 3rd most destructive hurricane in history. Rains up to 30 inches.

*If applicable, place additional information, summary, or comments on back of form.

APPENDIX C

INDIVIDUAL NATURAL DISASTER REPORT*

ate and Duration	Type (name)	Location (total area involved)
June 1953 twn 4-5:30 p.m. about 5:10 p.m." -Hight (1956) asting about 20 minutes	Tornado	Worcester, Massachusetts

ypes of Injuries		Types of Property Damage	Incidence of Disease
injured	# killed	$ estimate	(types and extent)
bout 1,500	93	$53 million	

ospitalized 570	fatalities 90*
ajor injuries 438	
inor injuries 867	

Sources: Dunlop (1954)
Hight (1956)
*Maher (1954)

If applicable, place additional information, summary, or comments on back of form.

APPENDIX D

LIST OF SURROGATES

Utilities

broken water mains
broken sewer lines
downed power/phone lines (oblique only)
contaminated reservoirs/wells
disrupted traffic signals
power plant damage
water supply station damage (pump)
natural gas supplies (plant)

Streets

obstructed by trees/poles
obstructed by structural debris
collapsed bridges
disrupted road surface
collapsed elevated roadways
road washout

Structural Damage

roofs off
trees/poles fallen on structures
structure off foundation
foundation settled
concrete embutments disrupted
mobile homes displaced
fallen towers, steeples, a.c. units, stacks
fallen radio/tv towers
fallen advertising display
damage to oil tanks, industry
garages/out buildings damaged

Vegetation

stripped, branches down
silt covered, trampled
uprooted

Miscellaneous

boats/commercial vessels displaced/beached
small, local landslides
passenger vehicles overturned
railroad tracks blocked or damaged
fallen fences
large animal carcasses

THE UNIVERSITY OF TEXAS
HEALTH SCIENCE CENTER AT HOUSTON
SCHOOL OF PUBLIC HEALTH

713/792 2121

P.O. BOX 20186
HOUSTON, TEXAS 77025

APPENDIX E

LETTER TO AGENCIES, LISTS OF QUESTIONS, AND

LIST OF PEOPLE INTERVIEWED

Dear

Thank you for agreeing to meet with us to discuss our project. As I mentioned on the telephone, we are developing potential uses for aerial photography in times of disaster. Specifically we would like to identify ways in which this technology could minimize or alleviate public health problems following a disaster. For example, areas of stagnant or contaminated water which might attract mosquitoes and thus lead to an outbreak of encephalitis could be pinpointed. Preventive steps could be taken against these sources before a problem developed.

The goals of our project are (1) to develop a procedures manual on using aerial photography as an aid to identifying and solving public health problems during a disaster and (2) to recommend skills and roles of a public health/remote sensing team to implement the procedures which would aid disaster-responding agencies.

At present we are focusing on Texas and are attempting to identify agencies and organizations on the various levels of government who respond to disasters. The tasks and functions of these agencies are nowhere extensively discussed in the literature and, more importantly, the experience of the people who deliver disaster relief is not published. Thus, we have found it necessary to meet with people working in this area in order to find applications of aerial photography which are useful.

We thought it might facilitate discussion at our meeting if we first sent you a list of questions we wished to discuss.

Sincerely,

Marjorie Rush
Principal Investigator

APPENDIX E

HEALTH PROBLEMS: QUESTIONS PROPOSED FOR DISCUSSION

1. What are the major community health problems encountered in disasters you have experienced?

2. Were any of the health problems you experienced due to contaminated or stagnant water?

If so, give specific examples, i.e., type and extent of disease.

3. Were any of the health problems you experienced due to crowding and thus unsanitary conditions of relief shelters?

If so, give specific examples, i.e. type and extent of disease.

4. Were any of the health problems you experienced due to contaminated food supplies?

If so, give specific examples, i.e., type and extent of disease.

5. Were any of the health problems you experienced due to exposure to dead animals and/or humans?

If so, give specific examples, i.e., type and extent of disease.

6. Were any of the health problems you experienced due to a vector problem (i.e., mosquitoes, flies, rats, etc.) aggravated by the respective disaster?

If so, give specific examples, i.e. type and extent of disease.

7. Have snakes ever been a problem in any of the disasters you have experienced?

8. Other than trauma cases, (cuts, fractures, etc.) can you point out any other significant areas where health problems could occur?

9. To what extent are trauma cases prevalent in disasters you have experienced?

10. How can a "disaster team" best intervene to minimize death, disability, and/or suffering?

APPENDIX E

AGENCY FUNCTIONS: QUESTIONS PROPOSED FOR DISCUSSION

1. What functions does your agency or department perform during a disaster?

2. What are the interrelationships between your agency or department and other levels of government? I.e., What is the "chain of command?"

3. What resources are available to your agency or department? E.g., a written disaster plan, maps of the city sewage, water and gas systems, shelters and manpower. How are volunteers incorporated into relief activities?

4. To what extent do disaster victims use your services?

5. How could the services you are prepared to provide be more widely used?

6. What disasters have you been involved in and what were some major problems you encountered?

7. How could you use aerial photos in your job?

APPENDIX E

LIST OF PEOPLE INTERVIEWED

Marion P. Bowden
Deputy State Coordinator, State EOC
Austin, Texas

William Brady
EOC Director
Galveston County, Texas

John Caswell
Executive Assistant Director
City of Houston
Emergency Operating Center
Houston, Texas

Frank Dickerson
Game Warden
Disaster District Committee, Representative
Texas District 2A
Houston, Texas

Col. Dean Ewing
DCPA Medical Officer
Washington, D.C.

Gerald W. Gillespie
Disaster Medical Services
Texas State Department of Health
Austin, Texas

Dr. Joe Goldman
Storm Research Center
University of St. Thomas
Houston, Texas

Lee Gruklkay
State Employment Commission
Disaster District Committee, Representative
Texas District 2A
Houston, Texas

Dr. W.W. Kemmerer
Director
Galveston County Health Department
Galveston, Texas

APPENDIX E

Richard W. Keyes
Regional Liasion Officer
Division of Disaster Emergency Services
Texas Department of Public Safety
Houston, Texas

Robert Lansford
State Representative to DCPA
State EOC
Austin, Texas

C.O. Layne
State Coordinator, State EOC
Austin, Texas

Jim Lynch
Emergency Medical Services Division
Texas State Department of Health
Austin, Texas

Leonard Marks
Aeronautics Commission
Disaster District Committee
Representative

Max McIntyre
Emergency Medical Services Division
Texas State Department of Health
Austin, Texas

Al Richmond
Resources Technology Corporation
Nassau Bay, Texas

Jesse Root
Emergency Medical Services Division
Texas State Department of Health
Austin, Texas

Tom Ross
Department of Public Welfare
Disaster District Committee Representative
Texas District 2A
Houston, Texas

C.L. Russell
Captain, Texas Highway Patrol
Chairman of Disaster District Committee
District 2A
Houston, Texas

APPENDIX E

William Tidball
Deputy Director, Region VI
Federal Disaster Assistance Administration
Dallas, Texas

Mattie E. Treadwell
Chief Field Officer, Texas
Region 5, DCPA
Austin, Texas

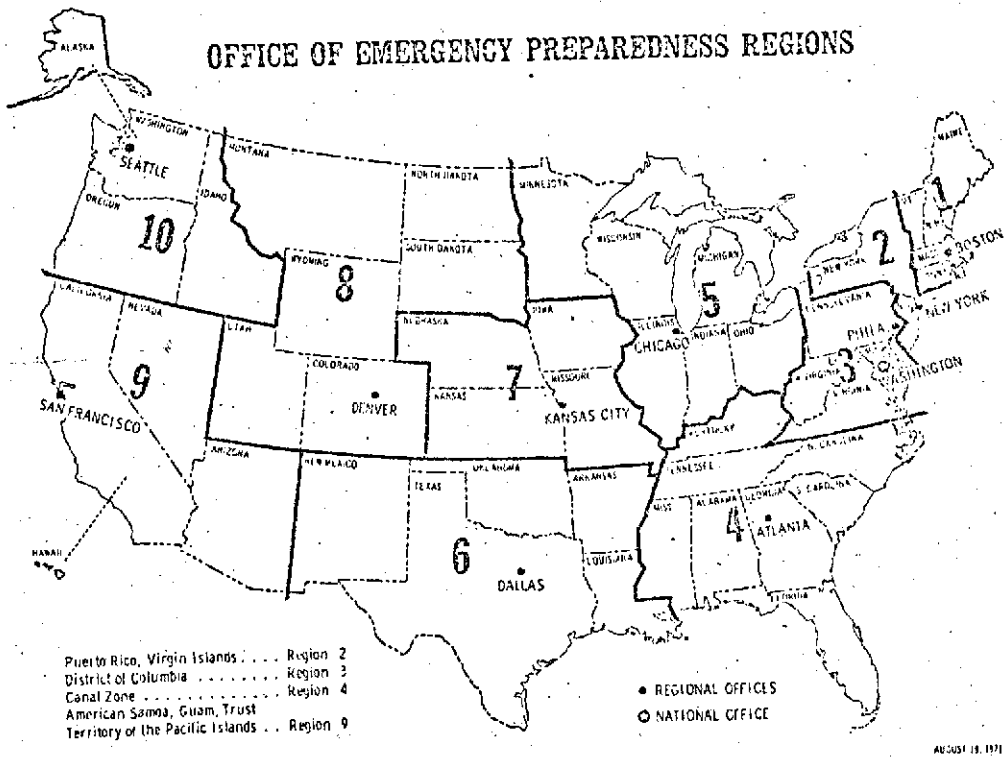
Bruce Wolly
Emergency Medical Services Division
Texas State Department of Health
Austin, Texas

Mike Warren
Red Cross
Houston, Texas

Wayne Wentworth
Parks & Wildlife Department

APPENDIX F

OFFICE OF EMERGENCY PREPAREDNESS REGIONS

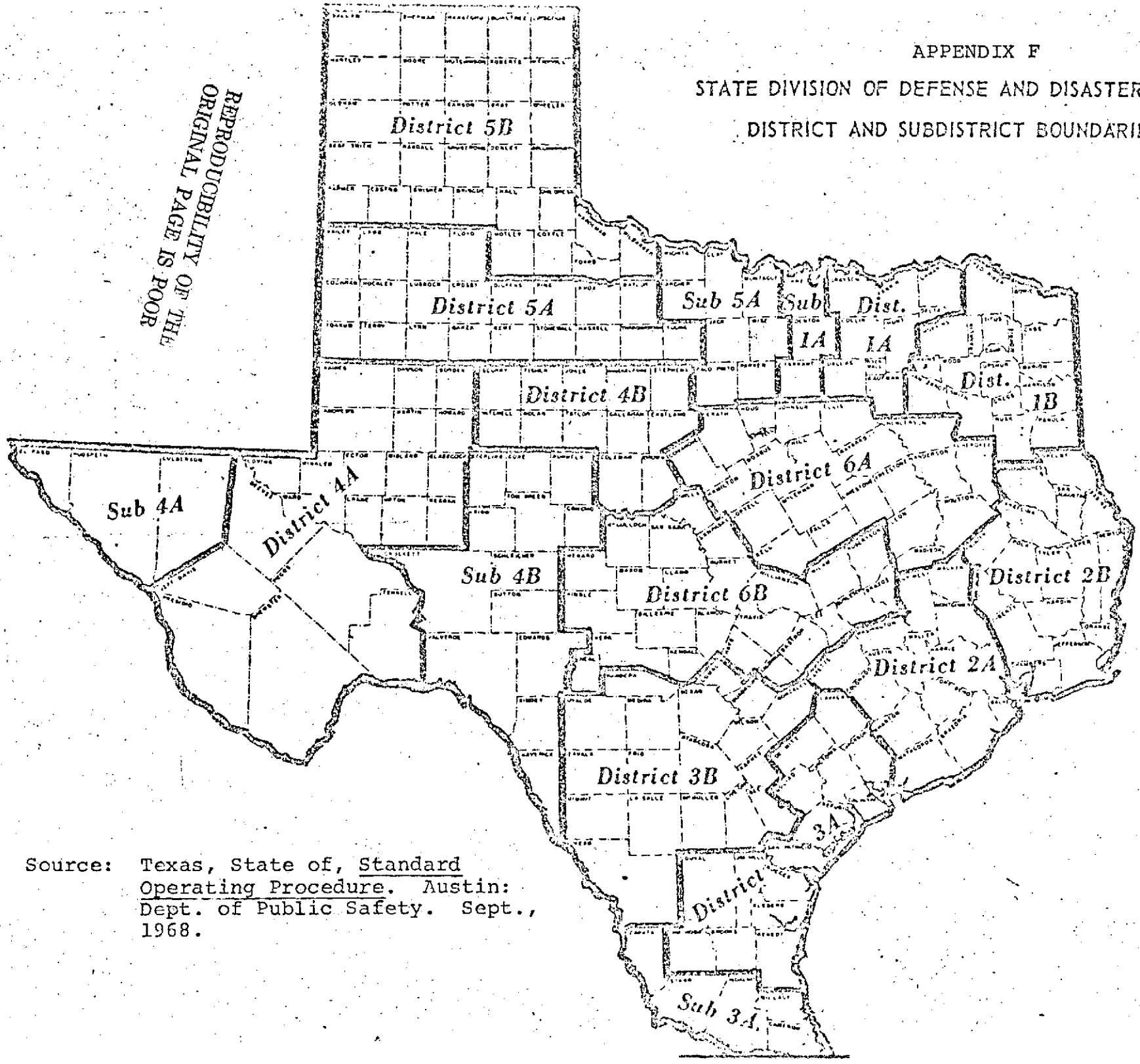


Source: Office of Emergency Preparedness, Federal Disaster Assistance Handbook for Government Officials, March, 1969.

APPENDIX F

STATE DIVISION OF DEFENSE AND DISASTER RELIEF

DISTRICT AND SUBDISTRICT BOUNDARIES

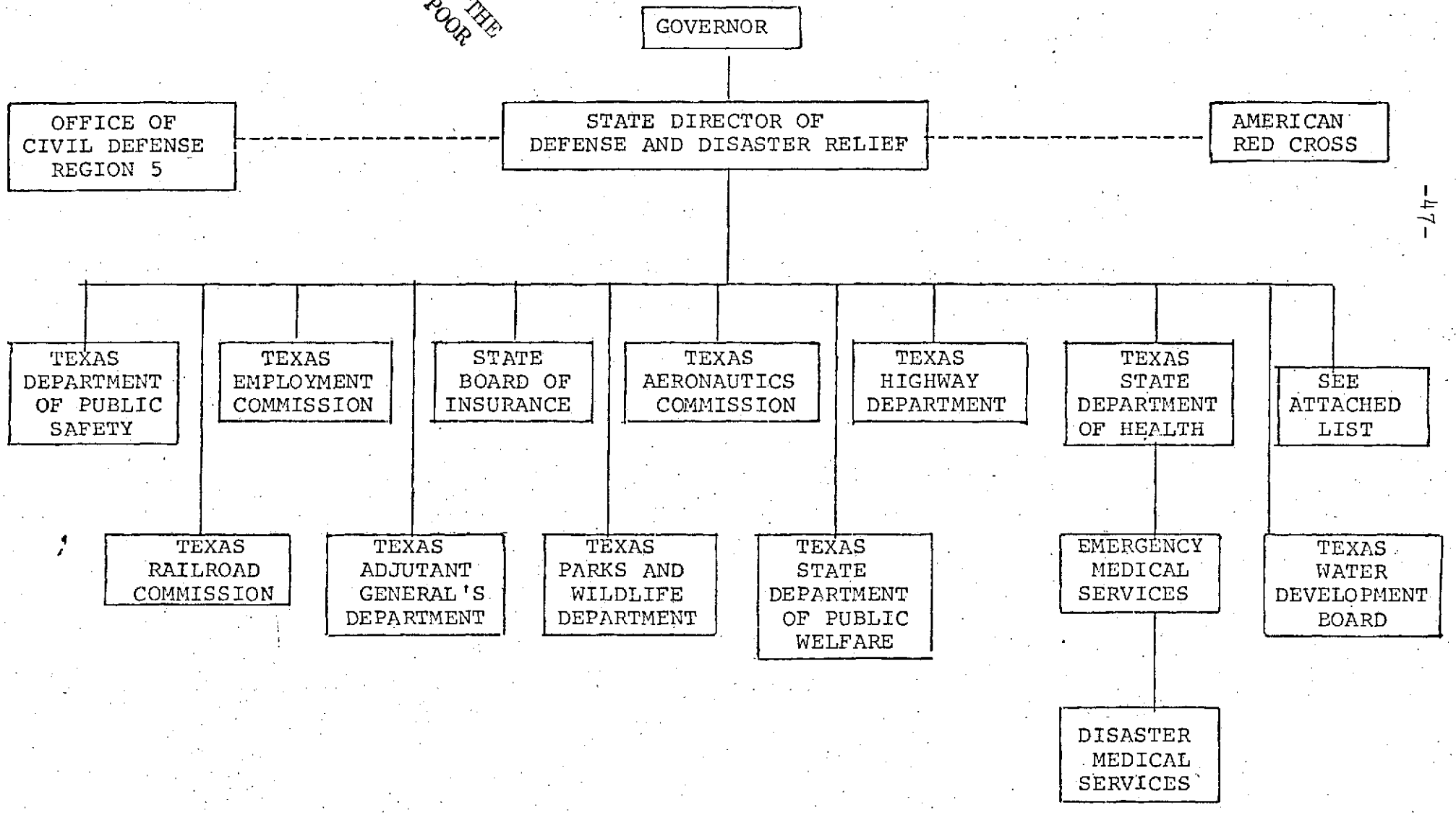


Source: Texas, State of, Standard Operating Procedure. Austin: Dept. of Public Safety. Sept., 1968.

APPENDIX F

STATE LEVEL AGENCIES

TEXAS



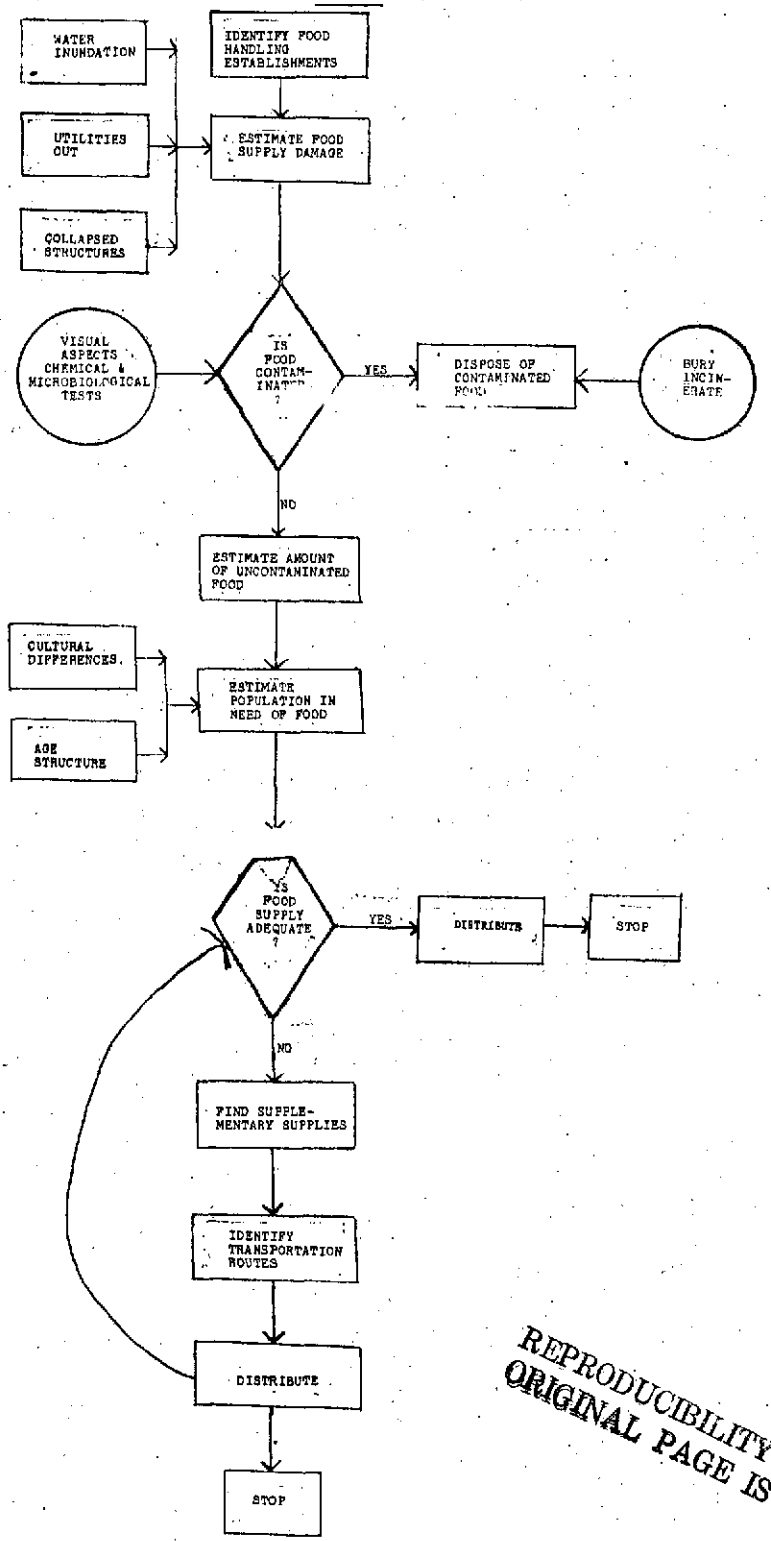
APPENDIX F

Agencies on the Defense & Disaster Relief Council

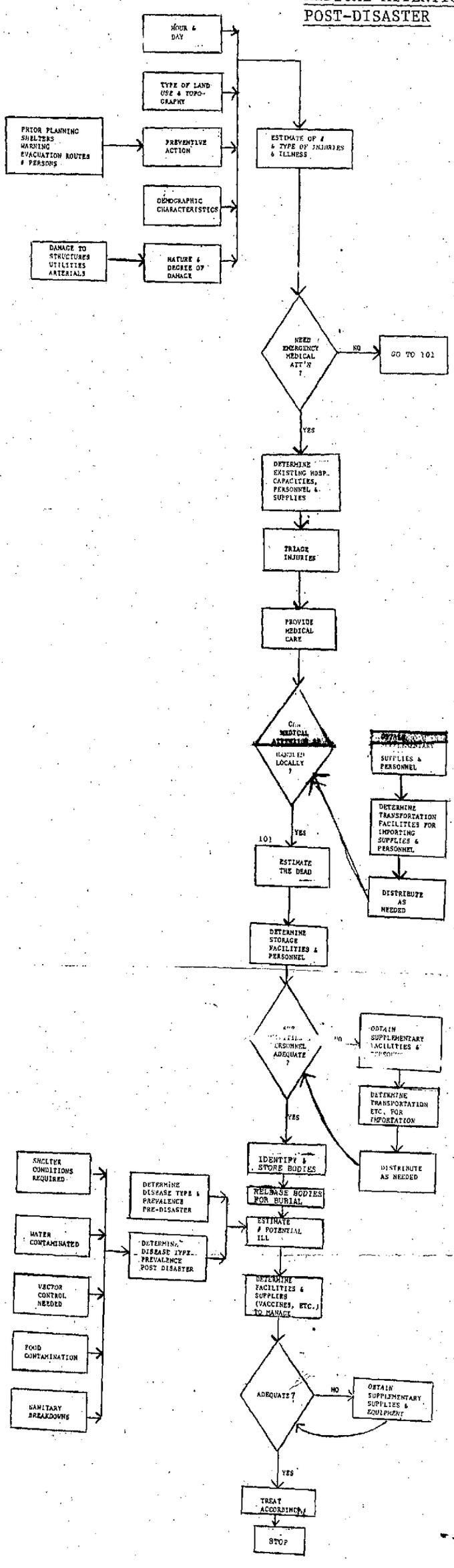
Agriculture Department
Texas Air Control Board
Attorney General
State Auditor
State Building Commission
Comptroller of Public Accounts
Board of Control
Texas Education Agency
Texas Industrial Commission
Texas Board of Mental Health and Mental Retardation
Veterans' Affairs Commission
Water Quality Board
Water Rights Commission
Texas Forest Service
Texas Civil Air Patrol Commission
Division of Disaster Emergency Services
Texas Department of Community Affairs
American Red Cross
Texas State Technical Institute

APPENDIX G

FOOD



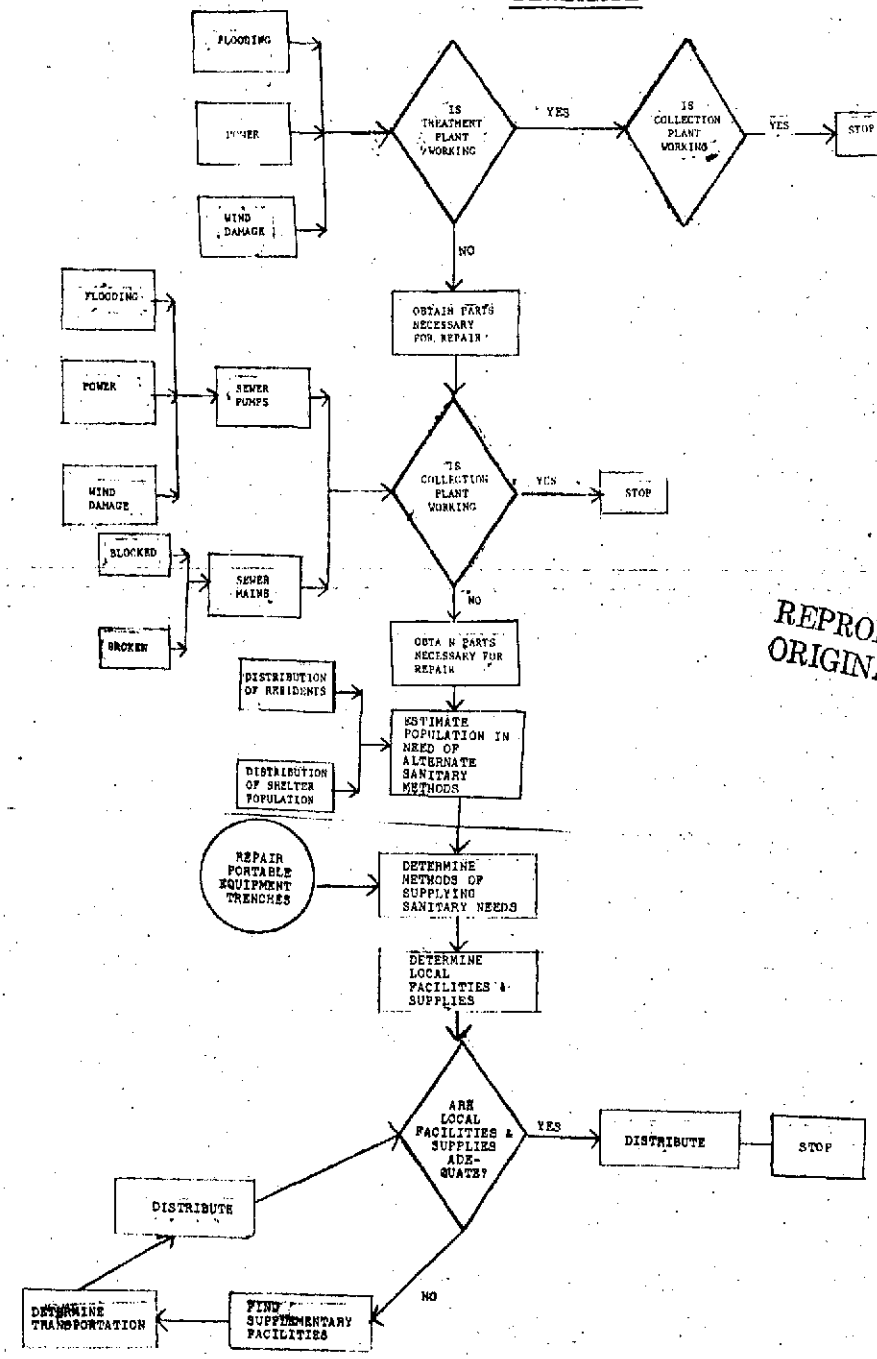
MEDICAL ATTENTION POST-DISASTER



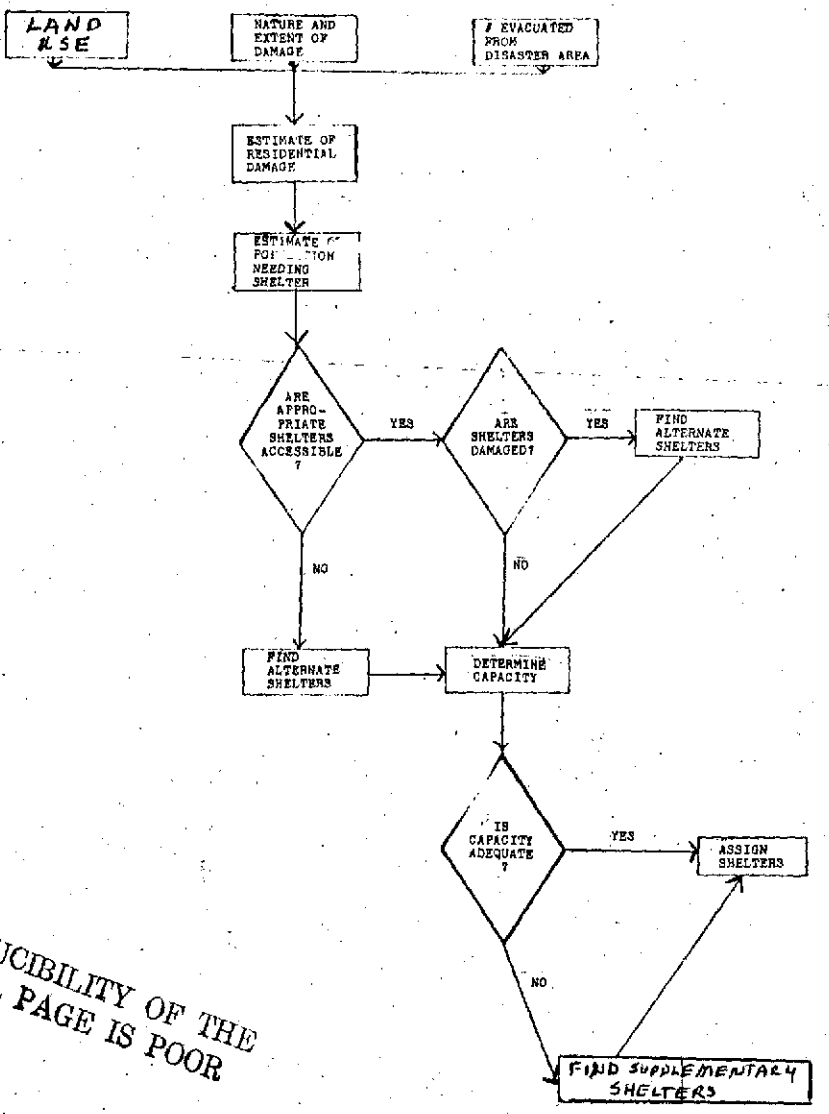
FOLDOUT FRAME 1

FOLDOUT FRAME 2

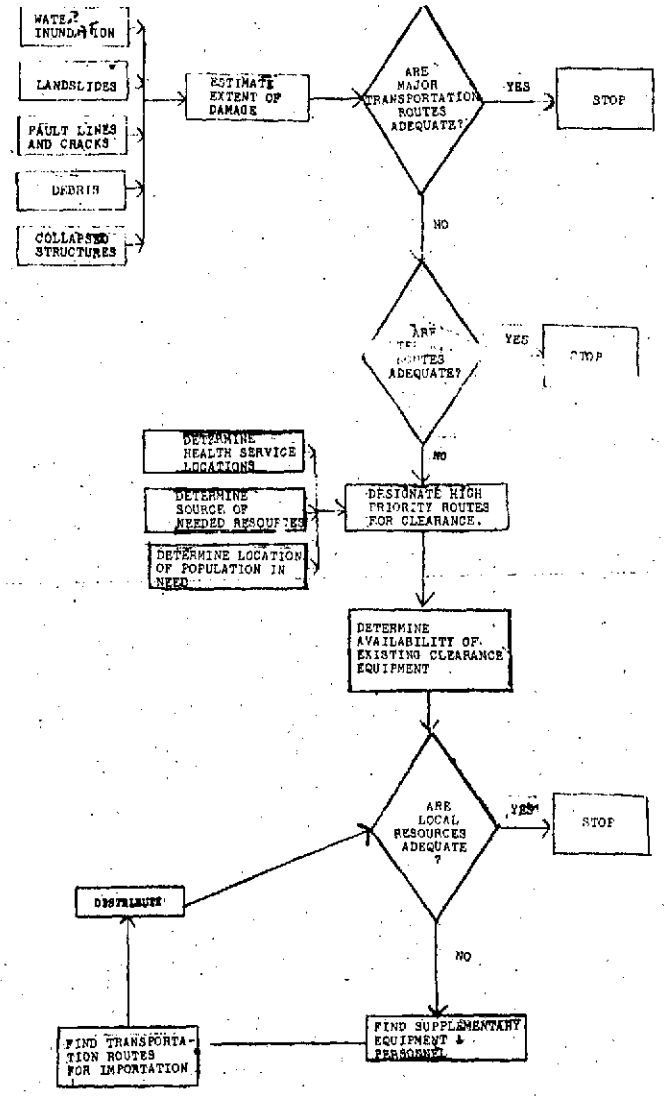
REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR



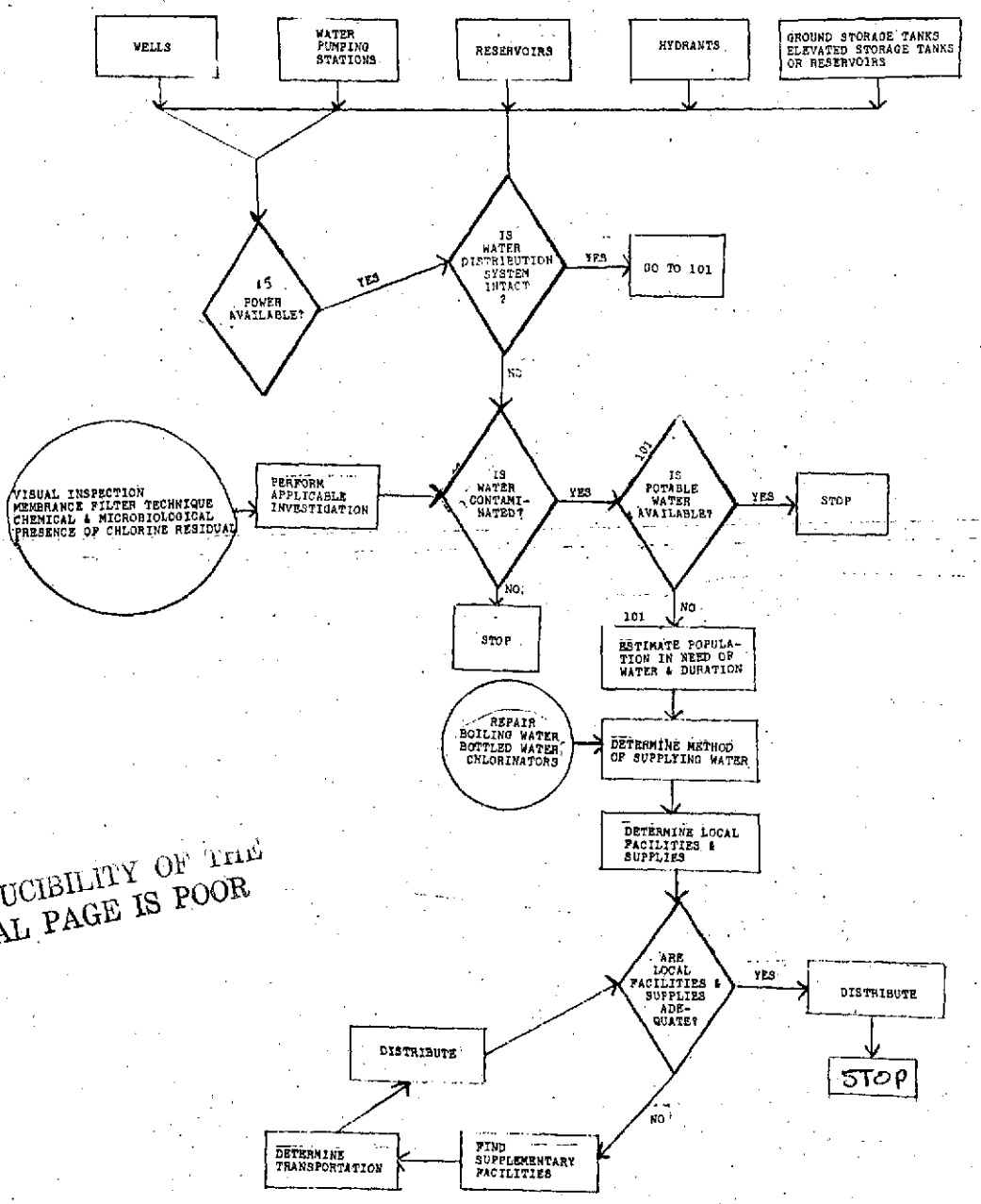
SHELTER



TRANSPORTATION



WATER



APPENDIX H

LIST OF INTERVIEWS TO VERIFY FLOW DIAGRAMS

Eddie Barr, Director
Emergency Operating Center
Galveston, Texas

Parks Bowden, Director
Emergency Operating Center
State of Texas
Austin, Texas

A. D. Catterson, M.D.
Disaster Medical Services Sub-Committee
Harris County Medical Society
Houston, Texas

Mike Crisswell
Department of Public Works
Galveston, Texas

Artis M. Duty
Sanitary Engineer
Water Division
Department of Public Works
Houston, Texas

James Havens
Department of Public Works
Galveston, Texas

Lou Hollar
Pollution Control
City Health Department
Houston, Texas

Joe Johnson
Sewer Division
Department of Public Works
Houston, Texas

Bob Lansford
State Representative to the DCPA
Emergency Operating Center
State of Texas
Austin, Texas

Carol MacLane
Department of Public Health
Galveston, Texas

Robert MacLean, M.D.
Communicable Disease Division
City Health Department
Houston, Texas

Joe Nadon
Department of Transportation
Galveston, Texas

Charles W. Nash
Pollution Control
City of Houston Health Department
Houston, Texas

Albert Randall, M.D.
Director
City Health Department
Houston, Texas

Make Warren
Red Cross Disaster Services
Houston, Texas

Charlie Williams
Sewer Division
Department of Public Works
Houston, Texas

Budget

Expenditures 11-1-73 - 10-31-74

Personnel	23,548.85
Fringe	1,144.37
Consumable supplies	67.01
Other expenses	10.00
Indirect	10,596.98
Consultant	100.00
Travel	1,429.59
Total	36,896.80

Proposed 2nd Year Budget

		%	Salary	Fringe	Total
1.	Personnel				
	Research Associate/ Coordinator	100	$12,500	925	13,425
	Research Statistical Aide	50	3,228	262	3,490
	Secretary	25	1,614	131	1,745
			$17,342	1.318	18,660
2.	Supplies				
	Office supplies, xeroxing	200			200
3.	Special Costs				
	Phone	100			
	Film & processing 20 x 7.40	148			
	Postage	140			
		388			388
4.	Travel				
	Response team to disaster sites	2,000			
	Per diem (5 persons x 12 days x 55/ day)	1,800			
	SPH to NASA ($5.95 x 50 trips)	298			
	Association of Civil Defense Directors Annual Meeting and Regional Meeting	800			
	Per Diem (2 persons/ 6 days)	420			
		5,318			5,318
5.	Overhead				
	45% S + W	8,397			8,397
6.	Consultants	2,000			2,000
7.	Transfer from 1st year	2,000			2,000
					$34,963